Grass Growing for Profit.

EDITED AND PUBLISHED BY
WILLIAM S. MYERS, F.C.S., Director,
Nitrate of Soda Propaganda,
Late of New Jersey State Agricultural College,
12-16 JOHN STREET, NEW YORK.

GRASS GROWING

FOR PROFIT.

A Short Compilation of Experimental Work on the Effects of Nitrate of Soda on Hay Crops.

Including Some Directions for the Preparation of Land and Harvesting the Crop.

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1. Product of one square foot of ground in field yielding over three tons per acre of cured timothy hay.

2. Product of one square foot of ground in adjoining field (not fertilized with Nitrate of Soda) yielding one ton per acre of cured hay.

Highland Experimental Farms, New York.

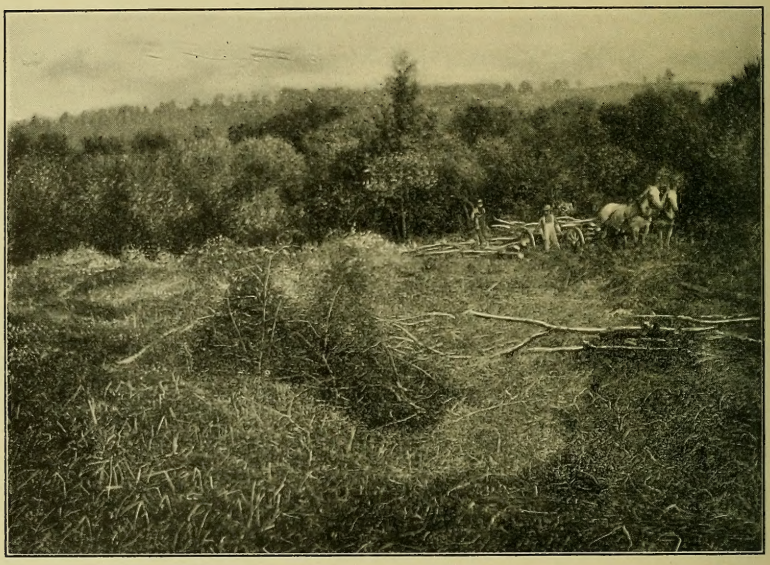
Grass Growing for Profit.

Approximately sixty millions of tons of timothy hay are grown every year in the United States on about forty millions of acres of meadow-land. Beginning at the seaboard and going west, the chief hay-producing States are: New York, Pennsylvania, Missouri, Ohio, Michigan, Indiana, Illinois, Wisconsin, Iowa and Kansas. New York alone has nearly five millions of acres on which is produced upwards of six millions of tons of hay. These ten States, which may be said to constitute the Hay Belt of the United States, have a total of 27,140,365 acres on which were grown in 1903, 40,326,229 tons of hay. These figures are mentioned to show the magnitude of our grass-growing industry. Of course, grass is grown more or less extensively in all of the States, but the States mentioned are the leaders and produce the great bulk of our annual crop of timothy hay, and in 1903 they produced 67 per cent. of the total crop.

Timothy and related grasses feed heavily on Nitrogen; they are able to transform it completely into wholesome and digestible animal food. When full rations of plant food are present a good crop of grass will remove about the equivalent of the active fertilizer ingredients of 300 pounds of Nitrate of Soda, 200 pounds sulphate of potash and 400 pounds of Peruvian guano or phosphate of high grade. These amounts are recommended to be applied per acre as top-dressing for old grass lands where intensive fertilization is well understood and practiced; and if wood ashes are available 600 pounds per acre will be very beneficial in addition to the above. Grass lands get sour easily, especially when very old, and when they do, one ton of lime per acre should be harrowed in before seeding down anew. The seeding should be done before September, and the above-mentioned ration should be used as a top-dressing the following spring, as soon as the grass begins to show growth.

If all the conditions are favorable, from three to five tons of clean barn-cured hay, free from weeds, may reason-

ably be expected. When grass crops are heavy and run as high as four and one-half or more tons per acre field-cured, it is safe to allow 20 per cent. shrinkage in weight for seasoning and drying down to a barn-cured basis. Nitrate of Soda, the chief constituent of the prescribed ration, pushes the grass early and enables it to get ahead of all weeds, and the crop then feeds profitably and fully on the other manurial constituents present in the fertilizer mentioned in the formula and present in the soil.



Clearing Land for Seeding.

When Nitrate costs about $50.00 per ton and clean hay sells $16.00 per ton the financial results are very satisfactory. Nitrate can sometimes be used alone for a season or two and at very great profit, but a full grass ration is better in the long run for both the soil and crop. *Generally speaking, 100 pounds of Nitrate, if used under proper conditions, will produce an increase of from 1,000 to 1,200 pounds of barn-cured, clean timothy hay, the value of which will average from $8.00 to $10.00.* The cost of 100 pounds of Nitrate is likely to average $2.30 to $2.60. *It pays well to use Nitrate liberally on grass lands.*

A reliable, heavy Top-Dressing formula for Grass Lands per acre:

300 lbs. Nitrate of Soda.
200 lbs. muriate of potash, or 1,000 pounds of wood ashes.
400 lbs. Peruvian guano or acid phosphate.

900 lbs.

Making Two Blades of Grass Grow Where One Blade Grew Before.

Abstract and Review of Rhode Island Experiments.

Grass is a responsive crop and the part played by mineral chemical fertilizers, as has been proven in Rhode Island, show the striking effect of Nitrate on yields and feeding quality.

Since all the other fertilizers were alike for the three plats and had been for many years, and since the general character of the soil and the treatments the plats had received were uniform, any differences must be ascribed to the influence of the varying quantities of Nitrate of Soda. These differences, so far as they are shown by the weights of the crops for four years are given in brief below:

Yield of Cured Hay Under Different Rates of Nitrogenous Fertilization.

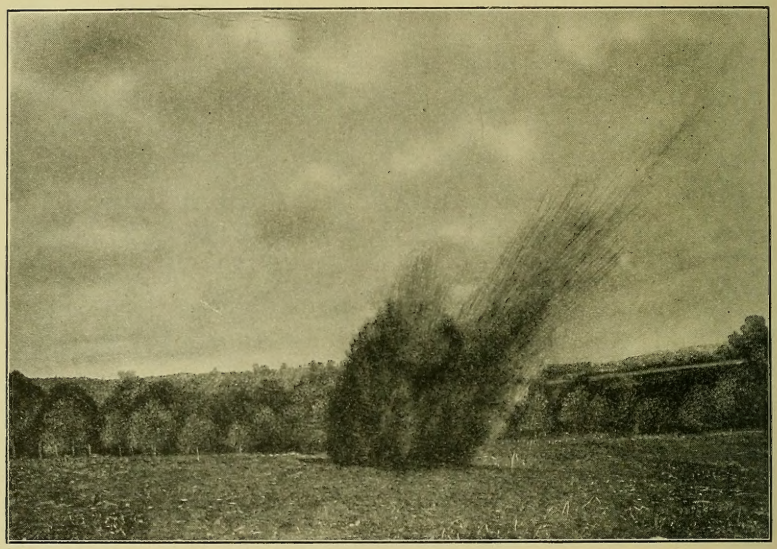
Nitrate of Soda applied	Yield of Cured Hay 1899 Lbs.	1900 Lbs.	1901 Lbs.	1902 Lbs.	Average Yields in Tons.
None	5,075	4,000	3,290	2,950	1.9
150 lbs. per acre*	6,300	5,600	5,550	4,850	2 8
450 lbs. per acre*	6,913	8,200	9,390	8,200	4.1

*Amount slightly reduced in 1901 and 1902.

What the Figures Show.

These figures show a uniform, consistent and *marked advantage from the use of Nitrate Nitrogen;* and the effect of its absence is shown by the steady decline of the yields on the no-Nitrate plat from year to year. In each year the use of 150 pounds of Nitrate gave increased yields over the plat without Nitrogen, the gain varying from 1,200 to almost 2,300 pounds, an average gain of about seven-eighths of a ton of hay. Three times this amount of Nitrate did not, of course, give three times as much hay, but it so materially increased the yield as to show that it was all used to good advantage except, perhaps, in the second year. This was an exceptionally dry year and but one crop could

be cut. The advantage from the Nitrate showed strikingly in the production of a rapid and luxuriant early growth while moisture was still available. This supply of readily soluble food comes just when it is most needed, since the natural change of unavailable forms of Nitrogen in the soil to the soluble Nitrates proceeds very slowly during the cool, moist weather of spring. The full ration of Nitrogen, 450 pounds of Nitrate, more than doubled the yield of hay over that produced on the no-Nitrate plat in 1900 and in the next two years it nearly tripled the yield. The average



Types of Characteristic Rock Shattering (1).
Preparing Land for Seeding.

increase over the 150-pound plat was one and three-tenths tons and over the plat without Nitrogen was two and five-eighths tons.

Effect on Quality of Hay.

How Nitrate Improves the Quality of the Hay.

Almost as marked, and certainly more surprising and unexpected, was the effect of the Nitrate upon the quality of the hay produced.

The hay from the plats during the first season was of such diverse character that different ton values

had to be placed upon it in estimating the profit from the use of fertilizers. That from the no-Nitrate plat, since it contained so much clover at both cuttings, was considered worth only $9.00 a ton; the first cutting on the small Nitrogen ration was valued at $12.00 and the second cutting at $10.00; while $16.00 and $12.00 were the values given to the first and second cuttings respectively on the plat receiving the full ration of Nitrate.

But the reduction in the percentage of clover was not the only benefit to the quality of the hay. The Nitrate also decreased the proportion of redtop as compared with the finer timothy. This tendency was noticed in the second year, when a count of the stalks on selected equal and typical areas showed 13 per cent. of timothy on the 150-pound plat, and 44 per cent. on the 450-pound plat. In the third year the percentages of timothy were 39 per cent. and 67 per cent., respectively, and in the fourth year the differences were even more marked.

An Alkaline Soil Necessary for Grass.

Timothy is a grass which will not tolerate an acid soil, and it is probable that the liming given these plats in 1897 did not make them as "sweet" as would have been best for this crop. Now, when Nitrate of Soda is used by plants, more of the Nitric acid is used than of the soda and a certain portion of the latter, which is an alkali, is left to combine with other free acids of the soil. This, like lime, neutralizes the acids and thus "sweetens" the soil for the timothy. Redtop, on the contrary, does well on soils which are slightly acid, and so would have the advantage over timothy in a soil not perfectly sweet. With the assistance of the soda set free from the Nitrate, the timothy was more than able to hold its own and thus to make what the market calls a finer, better hay; and since the market demands timothy and pays for it, the farmer who sells hay is wise if he meets the demand.

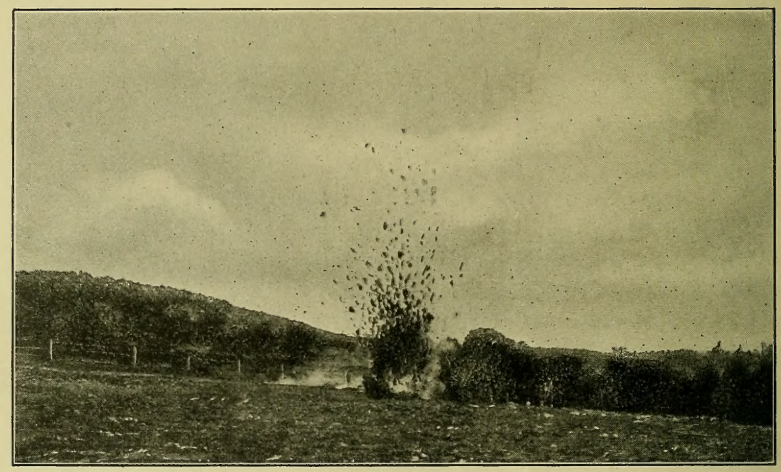
How Nitrate Neutralizes Soil Acids and Sweetens the Soil.

Financial Profit from Use of Nitrate.

How It Pays.

Frequently more plant food is paid for and put on the land than the crop can possibly use, the excess being entirely thrown away, or, at

best, saved to benefit some subsequent crop. This was far from the case in these trials. Indeed, it was found by analysis of the hay that more potash was removed by the crops of the first two years than had been added in the muriate used, consequently the amount applied upon each plat was increased in 1901 and in 1902. The Nitrogen requirement of the crops was found to be slightly less than was supplied in 450 pounds of Nitrate and the amount was reduced to 400 pounds in 1901, and to 415 pounds in 1902. The Nitrate on the second plat was also reduced in pro-



Types of Characteristic Rock Shattering (2).

portion. The phosphoric acid, however, was probably in considerable excess, since liming sets free phosphoric acid already in the soil and so lessens the apparent financial profit; but not to an excessive degree.

Excess of Value of Hay Over Cost of Fertilizers.

Nitrate of Soda applied	1899	1900	1901	1902	Average
None.....	$6.09	$13.42	$12.13	$7.44	$9.77
150 lbs.*.....	14.34	20.37	23.97	16.52	18.80
450 lbs.*.....	19.62	30.40	40.70	32.74	30.86

* Slightly reduced in 1901 and 1902.

What Percentage of Water Does Hay Lose During Storage?

Hay which had been stored during the summer of 1901 was removed from the mow the following February, and found to contain 12.21 per cent. of water. A careful comparison of other moisture determinations of hay leads to the conclusion that 12.21 is a fair general average of the percentage of water in the best quality of barn-cured hay. Field-cured grass averages about twenty-five to twenty-eight per cent. of moisture. The loss of weight on storage is therefore about fifteen per cent. in drying down to 12.21 per cent.

The Bulletins of the Rhode Island Agricultural Experiment Station, or Farmers' Bulletin No. 77, published by the United States Department of Agriculture, tells how and when to use lime. Details of excellent grass experiments, to be found in recent Bulletins issued by the Rhode Island Agricultural Experiment Station, Kingston, Rhode Island, tell about Nitrate of Soda.

Nitrate of Soda as Used in Clark's Grass Cultivation.

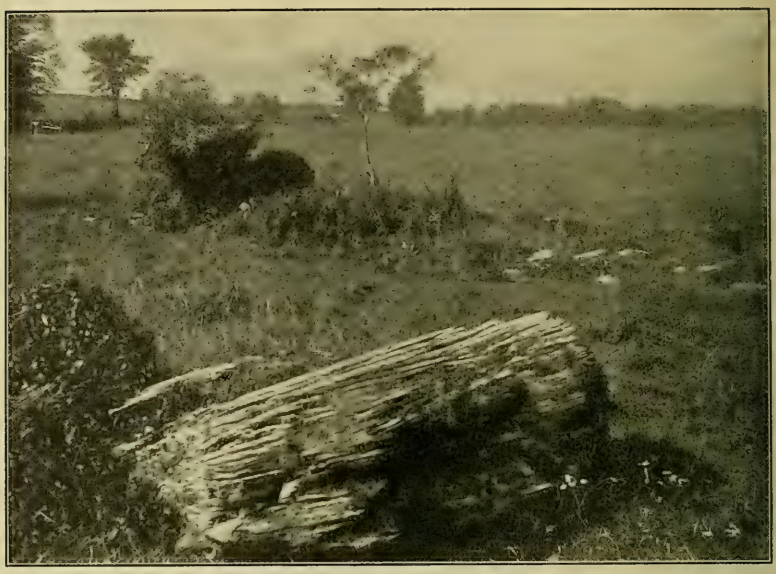
It may not be out of place here to mention the fact that Mr. Clark's success in obtaining remarkably large yields of hay for a number of years, an average of nine tons of cured hay per acre for eleven years in succession, has been heralded throughout the United States. He attributes his success largely to the liberal dressings of Nitrate of Soda which he invariably applies to his fields early in the spring, and which start the grass off with such a vigorous growth as to shade and crowd out all noxious weeds before they get fairly started and which result in a large crop of clean and high-priced hay.

How Careful Cultivation May Aid in the Profitable Use of Nitrate.

It is also known that many who have tested his methods have met with failure chiefly because they neglected to supply the young grass plants with a sufficient amount of readily available food for their use early in the spring when it is most needed, and before the organic forms of Nitrogen, which exist in the soil only in an insoluble form and which cannot be utilized by the plants as food, until converted into soluble Nitrates by the action of bacteria in the soil. This

does not occur to any great extent until the soil warms up to summer temperature when it is too late in the season to benefit the crops' early spring growth.

It is important that we always bear in mind the fact that our only source of Nitrogen in the soil for all plants is the remnants of former crops (roots, stems, dead leaves, weeds, etc.) in different stages of decomposition, and that



Rock before Blasting with One Pound of Forty Per Cent Dynamite.

in the early spring there is always a scarcity of Nitrogen in the soil in an available form, for the reason that the most of that which was converted into soluble forms by the action of the soil bacteria during the warm summer months of the previous year was either utilized by the plants occupying the ground at that time or has been washed down below the reach of the roots of the young plants by the melting snow and the heavy rains of late winter and early spring.

When we consider the fact that most plants require and take up about 75 per cent. of their total Nitrate Ammoniate during the earlier stages of their growth and that Nitrogen is *the* element most largely entering into the

building up of the life principle (or protoplasm) of all plants, it is plain that we cannot afford to jeopardize the chances of growing crops by having only an insufficient supply of immediately available Nitrogen when it is most needed.

Hay.

In the case of hay, from timothy and other grasses, the experiments that have been conducted answer the first question—"What shall I use"—as follows: Use Nitrate of Soda, because it is a food element that is especially needed; it is soluble in water and can be immediately taken up by the plants and supplies them with that which they need at the time they need it—it can be used by them early in the spring before other forms of applied Nitrogen are usable and before other soil

Same Rock Shattered by the Explosion of Dynamite.

supplies are available. The results of experiments conducted through a period of nine years, and in different sections of the State, show that upon soils which will produce crops ranging from one to three tons per acre, a gain in yield of from 9 to 54 per cent., or an average

increase of 32.7 per cent., may be expected from the use of from 100 to 150 pounds per acre, which would show an average gain in yield of 654 pounds per acre; based on the average yield of 1.25 tons per acre, the gain would be 820 pounds. This increase, at an average price of $12 per ton, would mean about $5 per acre, or $2 more than the cost of the material. A very satisfactory profit, when it is

Whole Field, except Center, Fertilized with Fourteen Per Cent. Acid Phosphate, Six Hundred Pounds; Sulphate of Potash, Two Hundred Pounds; **Nitrate of Soda**, Two Hundred Pounds; yield, three tons cured hay per acre.

Square in Center of Field had Six Hundred Pounds Acid Phosphate, and Two Hundred Pounds Sulphate of Potash, but *no* Nitrate of Soda; yield, one ton cured hay per acre.

Highland Experimental Farms, New York.

remembered that it is obtained at the same cost of labor and of capital invested in land.

Grass. According to Dr. Wheeler's experiments in Rhode Island, soils are less exhausted when complete fertilizers are used with Nitrate than when no Nitrate is used. The soda always left behind after the Nitrate of Soda is used up aids always the lime and potash, and unlocks the soil silicates and thereby frees potash,

lime and magnesia. The feeding value of hay is far greater when Nitrate is used as a fertilizer in this connection.

Rhode Island Formula.

Nitrate of Soda ..... 300 lbs.
Sulphate of potash ..... 200 lbs.
Acid phosphate or its equivalent, Peruvian guano... 400 lbs.

Practical Conclusions.

From these striking results it must be evident that grass land as well as tilled fields is greatly benefited by Nitrate, and that it would be to the advantage of most farmers to improve the fertility of their soils by growing good crops of grass, aided thereto by liberal fertilizing.

Top-Dressing Grass Lands.

The application should be in the form of a Top-Dressing, applied very early in the spring in order that the first growth may find readily available material for its support and be carried through the season with no check from partial starvation.

On land which shows any tendency to sourness, a ton to the acre of slaked lime should be used every five or six years. This makes the land sweet and promotes the growth of grass plants of the best kinds.

Lime should be sown upon the furrows and harrowed into the soil. *Top-dressing with lime after seeding will not answer, and, in the case of very acid soils, the omission of lime at the proper time will necessitate re-seeding to secure a good stand of grass.*

Economical and Profitable Practice.

All the elements of fertility are essential so that ordinarily complete fertilizers may be used, Nitrate being used as a Top-Dresser, though on some soils rich in phosphoric acid or potash, one or both of these ingredients may be used in small quantity. This is particularly true of phosphates after lime has been applied to the soil, since lime aids to set the phosphoric acid free from its natural insoluble combinations.

Grass seems to demand less phosphoric acid than was applied in the test; but it responds with increasing profit to applications of Nitrate of Soda up to 350 pounds to the acre when potash and phosphates are present.

On such soils as that of these plats, the best fertilizer combination for annual application appears to be:

400 pounds phosphate.
200 pounds sulphate of potash.
300 pounds Nitrate of Soda.

No stable manure has been used upon the field under experiment for over twenty years.

OPINION OF

U. S. DEPARTMENT OF AGRICULTURE.

FARMERS' BULLETIN No. 227,

(PREPARED IN THE OFFICE OF EXPERIMENT STATIONS.)

A. C. TRUE, Director.

EXPERIMENT STATION WORK.[a]

Vol. II. No. 10.

Top-Dressing Grass Land.[b]

Grass lands require special fertilizer treatment. After the meadow has been established on land of good fertility and in good tilth and crops of hay are removed each year, the original supply of plant food is diminished and the productiveness of the meadow necessarily decreases. In order to maintain its profitable yielding capacity the supply of plant food must be kept up through fertilization. The method of applying fertilizers presents some difficulties which are not encountered in fertilizing the soil for most of the other crops. The grass remains upon the land continuously for a series of years and there is no opportunity for plowing under green manure or applying barnyard manure or commercial fertilizers and incorporating the same into the soil from the time one crop is removed until the succeeding one is put in, as can be done in the culture of annual crops. Furthermore, the coarser undecomposed material of barnyard manure which remains upon the meadow is likely to be raked up with the hay, which is a decided disadvantage, and the manure sometimes also has

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a A progress record of experimental inquiries, published without assumption of responsibility by the Department for the correctness of the facts and conclusions reported by the stations.

b Compiled from Rhode Island Sta. Buls. 57, 71, 82, 90, 103.

the effect of reducing the quality of the grass by causing a rank growth and by the introduction of weeds. The use of commercial fertilizers on meadows has the advantage of leaving the barnyard manure produced on the farm available for other crops, to which it can be more readily and satisfactorily applied. If barnyard manure is to be used on a meadow it should be applied as a uniformly fine and well-rotted compost.

For the different reasons given, and also on account of the greater availability of the plant food they contain, certain commercial fertilizers are better adapted to top-dressing grass lands than barnyard manure. The farmer must know, however, the kinds and quantities of fertilizers best suited for this purpose, at what time the application should be made, and whether under ordinary conditions he may expect a profitable return. These questions have been studied by the Rhode Island Station in an experiment extending over a period of six years, and the results obtained are here briefly summarized.

The experiments were begun in 1899 on three plats, numbered 17, 19 and 21. Since 1893 these plats had been devoted chiefly to the growth of leguminous crops and had received annually 180 pounds of muriate of potash and a quantity of phosphoric acid approximately equivalent to an application of 1,200 pounds of acid phosphate containing from 13 to 14 per cent. of available phosphoric acid. During this same period plats 19 and 21 received each year 150 and 450 pounds of Nitrate of Soda per acre, respectively, while plat 17 received no Nitrogen and had probably not received this element for from fifteen to twenty years. In 1897 all plats were treated with one ton per acre of slaked lime. In 1898 7.5 pounds each of common red clover and redtop and 15 pounds of timothy per acre were sown, with barley as a nurse crop. The yields of hay obtained in 1899 were as follows: Plat 17, 5,075 pounds; plat 19, 6,300 pounds, and plat 21, 6,913 pounds per acre. The hay from the no-Nitrogen plat consisted almost entirely of clover, while the crop from the other two plats was largely redtop and timothy. The results of this season indicated that large crops of grass require considerable quantities of immediately assimilable Nitrogen applied early in the season, and that good crops of clover

can be grown on limed land without supplying Nitrogen in the form of commercial fertilizers. Allowing twenty per cent. for shrinkage in the hay and estimating the value of the different crops at from $9 to $15 per ton, plat 17 gave a difference of $6.09 per acre over the cost of the fertilizer applied; plat 19 a difference of $14.34, and plat 21 of $19.62.

In 1900, soon after the grass started to grow, all plats received the regular dressing of potash, phosphoric acid

The Tedders follow the Mowing Machines for rapid curing of heavy crops of hay.

and Nitrogen, but in 1901 the fertilizer application per acre was changed to 807.5 pounds of acid phosphate, containing 130 pounds of phosphoric acid; 200.52 pounds of muriate of potash, furnishing 100 pounds of potash, and 133.52 pounds of Nitrate of Soda on plat 19 and 400.56 pounds on plat 21, supplying 21 and 63 pounds of Nitrogen, respectively.

Throughout the entire experiment plat 17 received no Nitrogen; plat 19 a one-third ration, and plat 21 a full ration. The results obtained with the modified application

emphasized the need of properly adjusting the quantities of the different elements given in the fertilizer application. The reduction of the Nitrate of Soda from 450 to 400.56 pounds and of the acid phosphate from 1,200 to 807.5 pounds and the increase of the muriate of potash from 180 to 200.52 pounds reduced the cost of the application and resulted in higher profits. The treatment of the plats in 1902 was essentially the same as the year before, with the exception that the quantity of muriate of potash was raised to 303.26 pounds, furnishing 150 pounds of actual potash per acre. During the last two years of the six-year period the fertilization was the same as in 1902. The principal data secured in the experiment are shown in the following table:

Results Obtained in a Six-year Fertilizer Experiment on Grass Land at the Rhode Island Station.

Year.	General application.		Plat 17, no Nitrogen.		Plat 19, one-third ration.		Plat 21, full ration.	
	Potash.	Phosphoric acid.	Hay per acre.	Value of crop over fertilizer.	Hay per acre.	Value of crop over fertilizer.	Hay per acre.	Value of crop over fertilizer.
	Pounds	Pounds.	Tons.		Tons.		Tons.	
1899..... ...	88.31	164.1	2.54	$6.09	3.15	$14.34	3.46	$19.62
1900.....	90.38	191.1	2.00	13.42	2.80	20.37	4.10	30.40
1901.....	100.00	130.0	1.65	12.13	2.78	23.97	4.70	40.70
1902.....	150.00	130.0	1.48	7.44	2.43	16.52	4.10	32.74
1903.....	150.00	130.0	1.64	7.70	1.85	9.38	3.83	27.81
1904.....	150.00	130.0	1.25	3.60	2.05	10.71	4.07	30.36
Average....	. .. .	.....	1.76	8.40	2.51	15.88	4.03	30.27

The results for the six years show that without Nitrogen an average of 1.76 tons, with one-third the full application 2.51 tons, and with the full application of Nitrogen 4.03 tons of field-cured hay was secured per acre. A satisfactory stand of timothy was maintained for the six years only on the plat which received the full ration of Nitrogen, and this plat also produced the highest market grade of hay. It was found that where the full ration of Nitrogen was given a ton of field-cured hay removed from the soil 32 pounds of potash, 13.1 pounds of Nitrogen, and 6.5 pounds of phosphoric acid. In each of three years in which determinations were made more Nitrogen was supplied in the full ration than was removed by the crop. With potash and phosphoric acid alone the value of the crop per acre exceeded the cost of the fertilizers on an

average per year by $8.40; with one-third the full Nitrogen application, by $15.88, and with the full application of Nitrogen by $30.27. Determinations of the shrinkage in barn-curing hay showed that it ranged from about 13 to 19 per cent.

For three years an experiment was conducted on two plats to determine the best quantity of phosphoric acid to

Two Horse Hay Tedder, ready to operate.

be applied per acre. An average annual yield of 4.16 tons of barn-cured hay was obtained where 40 pounds of phosphoric acid was applied, and 4.54 tons of field-cured hay where 60 pounds was used. A potash test was conducted on the same plan. The average annual yield of field-cured hay where 150 pounds of potash were used was 5.1 tons per acre, and where 200 pounds were used 5.3 tons.

The data derived from the experiments show that good financial returns may be obtained from grass culture with the use of commercial fertilizers alone. The use of 400 to 500 pounds of acid phosphate and 300 to 350 pounds of muriate of potash and Nitrate of Soda per acre,

applied from April 15 to 25, is suggested as being best adapted for use as an annual top-dressing on grass lands where a good stand of timothy and redtop already exist, where a too great degree of soil acidity does not prevail, and where commercial fertilizers only are used.

FERTILIZING HAY CROPS.

From the California Experiment Station Annual Report, 1904.

(The Cereals Are Much Used for Hay Crops on the West Coast.)

The California experiments with fertilizers on hay crops, begun in 1901, were continued during the season of 1902-3. During the season of 1901-2 it was found that the use of Thomas phosphate slag and sulphate of potash with Nitrate of Soda did not pay as well as Nitrate of Soda

A Side-delivery Rake in Operation.
Highland Experimental Farms, New York.

used alone. The experiments during the last season were planned to test the availability of the phosphate after the first season. It was thought last year that there was a possibility that the insoluble slag phosphate would become more available the second season after applying it. The

plots used in the 1901-2 experiments were subdivided and given different applications of Nitrate of Soda used alone and in combination with sulphate of potash used at the rate of 300 pounds per acre.

The yield of hay was lower on both fertilized and unfertilized plots during the season of 1902-3 than it was in 1901-2. This difference is undoubtedly due to an unfav-

The Loader is of great service in handling hay quickly.

orable season. The late spring rainfall failed almost entirely, and to this no doubt must be attributed the decreased yield.

An inspection of the summary of results tabulated below shows that the heaviest yields of hay on both red and granite soils and the largest money returns per acre were obtained from the plots which were fertilized with phosphate during 1901-2. On red soil with oats the gain from the use of Nitrate of Soda on the plot which had phosphate the year previous was $11.70 per acre, as against only $3.72 per acre where the Nitrate was used on land having no previous fertilization.

On granite soil with oats, there was no gain from the phosphate. The use of Nitrate of Soda alone without previous fertilization yielded $9.44 per acre profit, while on the plots having phosphate applied the previous year, the gain was only $5.74 per acre.

The heaviest yield of hay and the largest profit per

acre in 1903 were obtained with wheat on granite soil which had an application of Thomas slag, sulphate of potash, and lime in 1902. Nitrate of Soda was used at the rate of 320 pounds per acre in 1903. The yield of hay was 5,772 pounds per acre, and the resulting profit $12.89 per acre. It should be remarked here, however, that this plot was fertilized at a loss of $21.50 per acre in 1902; and as the application of Nitrate was larger than was used on any other plot, the increased returns were at least partly due to the increased supply of the Nitrate. Through some misunderstanding, there was no corresponding wheat plot on granite soil with Nitrate only.

Whole Field, except center, Fertilized with Fourteen Per Cent. Acid Phosphate, Six Hundred Pounds; Sulphate of Potash, Two Hundred Pounds; Nitrate of Soda, Two Hundred Pounds; yield, three tons per acre of cured hay. Square in Center of Field had Six Hundred Pounds Acid Phosphate, and Two Hundred Pounds Sulphate of Potash, but *no* Nitrate of Soda; yield, one ton per acre of cured hay.

Highland Experimental Farms, New York.

The use of sulphate of potash in combination with Nitrate of Soda, on granite soil, did not pay in 1903. Potash was used at the rate of 300 pounds per acre. In most cases the fertilizer cost more than the increased crop of hay was worth; hence its use incurred a loss of from 76 cents to $4.57 per acre.

The experiments with Nitrate of Soda used alone were broadened in 1903 to test the efficacy of different amounts per acre and the division of the application into two doses. The results show that in 1903, 160 pounds of Nitrate of Soda per acre in one application yielded the largest profits, viz.: $9.44 and $8.90 per acre, respectively, on two plots, on granite soil. In all cases the yield was reduced when the fertilizer was put on in two applications; thus, with 160 pounds per acre applied in two doses, only $4.82 and $7.27 per acre were yielded by two plots on granite soil.

Fertilizer Experiments on Meadow Land.

(KENTUCKY AGRICULTURAL EXPERIMENT STATION BULLETIN, No. 23, FEBRUARY, 1890.)

On low and decidedly wet land:

TIMOTHY.

Kind of Fertilizer Used	Amount Per Acre in Pounds	Yield of Hay in Pounds Per Acre
Sulphate of potash	160	1,900
Muriate of potash	160	2,320
Nitrate of Soda	160	2,670
Sulphate of ammonia	130	2,520
No fertilizer	...	1,620
Stable manure	20 loads	2,200
Tobacco stems	4,000	3,350

Clearing and Reclaiming Lands.

In recent years, dynamite has come to be generally used for the preliminary clearing and reclaiming of land, and especially for the shattering and pulverizing of rocks and the removal of stumps. Modern tools and machinery, such as the disk-harrow and leveler and improved plows and scrapers, permit the preparation of land on the Atlantic Seaboard fully as workable, and as convenient in every way for the best improved heavy hay and harvesting machinery as is the case of lands of the Mississippi Basin. These remarks apply also to land adapted to general use as well as to farming.

Almost every farmer shall be able to clear from five to thirty acres of such land, and he may become an effective competitor of the more favored Western producer to a greater extent than ever before, if he chooses.

In the preparation of both old and new lands for grass, thorough tillage is desirable, and the surface of the ground should be well smoothed, in order that modern machinery may be operated successfully and economically. This remark applies especially to New York and Pennsylvania and to New England, where the character of the country is largely rolling and frequently rocky. Thousands of acres of virgin land remain in these States to be reclaimed for cultivation. From the standpoint of proximity to good markets, such lands should well repay the cost of clearing, if it be thoroughly done. Such a plan, with modern facilities, offers to the farmer in these States, an opportunity to increase his acreage and the productive capacity of his farm. This means an added value to every farmer's holding.

Photographs are shown in the text of the clearing of land for grass-seeding, including the removal of timber; and, secondly, the shattering of rocks by means of dynamite. Usually one pound of 40 per cent. dynamite will throw a large stump and will shatter a large rock in sufficiently small pieces to remove by wagon or stone-boat. After the land is cleared, the disk-harrow and leveler should be used to pulverize the soil and kill the weeds. Several harrowings are usually necessary for this purpose. During such harrowing, the mineral fertilizers and liming may be applied. Nitrate of Soda should not be used until the following Spring, and on new seeding 200 pounds to the acre of Nitrate of Soda as a top-dressing is all that should be used the first season. This applies, however, only to the first year of the new seeding. Afterwards, 300 pounds of Nitrate may be used, provided adequate mineral applications of phosphate and potash are made also.

When Nitrate is used alone as a top-dressing—that is, unless the minerals have been previously applied—100 pounds per acre is enough; but it should be remembered that to make as small an application as 100 pounds per acre requires considerable care, the tendency being, unless such care is exercised, to make the application unnecessarily heavier with consequent possible loss of profit.

Nitrate can sometimes be used alone some seasons at very great profit and, especially on old meadows, frequently the production of hay can be very materially increased. In the long run a full ration of the minerals is better for both the soil and the crop. Generally speaking, in the Hay Belt of the United States, two crops of grass may be grown at a profit every year.

Plot ready for Record of Weights to be Taken.
Highland Experimental Farms, New York.

Immediately after harvesting the first crop, the minerals and Nitrate should be applied, and a satisfactory formula is as follows. This applies to intensive practice:

200 lbs. Nitrate of Soda.
200 lbs. Sulphate of potash.
600 lbs. ground bone, or Peruvian guano or acid phosphate.

The illustrations shown in the text are intended to include the whole operation of the preparation and seeding of grass-lands, the application of fertilizers, the cutting and harvesting and storing of hay and preparation of the same for market. The photographs are taken from actual operations in the field and are intended to give a complete

outline of the whole industry of grass growing. The machinery and tools have been found to be very satisfactory and to do their work thoroughly in every respect.

The average yields per acre of field-cured hay on the uplands were as follows:

No-Nitrate, 3,180 pounds per acre.

Where 300 pounds of Nitrate were used, **8,340** pounds per acre.

The average yields on the lowlands were as follows:

No Nitrate, 6,985 pounds per acre.

Where 200 pounds of Nitrate were used, **8,712** pounds per acre.

Grades of Hay and Straw.

The following are the rules and regulations adopted by the Chicago Board of Trade for the inspection of hay and straw:

Choice Timothy Hay: Shall be timothy not mixed with over one-twentieth of other grasses, properly cured, bright, natural color, sound and well baled.

No. 1 Timothy Hay: Shall be timothy mixed with not more than one-eighth clover, red-top, and other tame grasses, properly cured, good color, sound and well baled.

No. 2 Timothy Hay: Shall include all timothy not good enough for No. 1, not over one-third mixed with other tame grasses, fair color, sound and well baled.

No. 3 Timothy Hay: Shall include all hay not good enough for other grades, sound and well baled.

No. 1 Clover Mixed Hay: Shall be timothy and clover mixed, with at least one-half timothy, good color, sound and well baled.

No. 2 Clover Mixed Hay: Shall be timothy and clover mixed, with at least one-third timothy, reasonably sound and well baled.

No. 1 Clover Hay: Shall be medium clover, not over one-twentieth other grasses, properly cured, sound and well baled.

No. 2 Clover Hay: Shall be clover, sound, well baled, not good enough for No. 1.

No Grade Hay: Shall include threshed timothy and all hay badly cured, musty, stained, or in any way unsound.

Choice Prairie Hay: Shall be upland hay, of bright color, well cured, sweet, sound and reasonably free from weeds.

No. 1 Prairie Hay: Shall be upland, and may contain one-quarter midland, of good color, well cured, sweet, sound and reasonably free from weeds.

No. 2 Prairie Hay: Shall be upland of fair color or midland of good color, well cured, sweet, sound and reasonably free from weeds.

717	716	715
No treatment.	320 lbs. Acid Phosphate.	160 lbs. Nitrate of Soda.
2200 lbs. hay per acre.	160 lbs. Nitrate of Soda.	3550 lbs. hay per acre.
	3840 lbs. hay per acre.	

Fig. 18.—These plats show in a very marked way the influence of Nitrate of Soda on the yield of hay. (Cornell Univ. Bulletin No. 232.)

No. 3 Prairie Hay: Shall be midland of fair color or slough of good color, well cured, sound and reasonably free from weeds.

No. 4 Prairie Hay: Shall include all hay not good enough for other grades and not caked.

No Grade Prairie Hay: Shall include all hay not good enough for other grades.

No. 1 Straight Rye Straw: Shall be in large bales, clean, bright, long rye straw, pressed in bundles, sound and well baled.

No. 2 Straight Rye Straw: Shall be in large bales, long rye straw, pressed in bundles, sound and well baled, not good enough for No. 1.

Tangled Rye Straw: Shall be reasonably clean rye straw, good color, sound and well baled.

Wheat Straw: Shall be reasonably clean wheat straw, sound and well baled.

Oat Straw: Shall be reasonably clean oat straw, sound and well baled.

All certificates of inspection shall show the number of bales and grade in each car or lot inspected and plugged; and, when for shipment, the final inspection and plugging, in order to ascertain the sound condition of each bale, shall take place at the time of shipment.

The fees for inspection shall be $3.00 per car, to be divided equally between the buyer and seller.

CORNELL UNIVERSITY AGRICULTURAL EXPERIMENT STATION.

Bulletin 232.

The most important result as shown, both in the growing crop and in the weights of hay was the influence of the Nitrate of Soda. In every instance where Nitrate of Soda was applied a marked increase in the vigor of growth as well as in the weight of hay was produced. The influence of the phosphoric acid and potash was much less marked in all instances. When Nitrate of Soda was doubled without increasing the acid phosphate or the muriate of potash the apparent increase in yield was more than doubled, but when the phosphoric acid was doubled without increasing the Nitrate of Soda or the muriate of potash the yield was decreased. (See cut on opposite page.)

RHODE ISLAND EXPERIMENT STATION.

Bulletin 104.

"Some readers of this Bulletin will recall the rabid attacks upon Experiment Station chemists made a few years ago in the agricultural press by the late Andrew H. Ward, of Boston, in which he denounced the chemists for not giving the same recognition to soda as to potash as a manure, upon the ground of its alleged ability to replace potash in plant production. To such as may have known of those published criticisms, the verdict against the

equality of soda in plant production returned in this experiment by the plants themselves, ought to remove any further doubt concerning the merits of the case. It can not be disputed, however, that soda is of some use in some manner with many varieties of plants, *when the supply of potash is quite limited,* and also with at least a few varieties of plants even in the presence of a fairly abundant supply of potash. Whether sodium salts would be rendered useless with all varieties of plants if the supply of potassium salts were greatly increased is a point which is not as yet fully proved, nor is it fully clear as yet in just what manner the sodium salt has been helpful in this particular experiment. This is a question which will be considered later in connection with the chemical analyses of the crops. It may, however, be stated here that sodium salts seem to liberate at least phosphoric acid and potash, so that under certain circumstances they may act as indirect manures. They also appear under certain conditions to prevent plants from assimilating large amounts of potash in excess of their needs, thereby conserving the potash supply within the soil. It does not appear unlikely, when the supply of potash is limited, that sodium salts may aid in some degree in performing some function of potassium."

1. Without Nitrogen. 2. ⅓ Ration of Nitrogen. 3. Full Ration of Nitrogen.
All three fertilized alike with muriate of potash and acid phosphate.—R. I. Bul. 103.

The After-effect of Sodium and Potassium Salts.

(From RHODE ISLAND Agricultural Experiment Station Bulletin, No. 106, May, 1905.)

This experiment was a continuation of tests upon the same forty-eight plots upon which annual applications of sodium and potassium salts had been made since 1894.

In 1902, 1903 and 1904 no further applications of sodium or potassium salts were made, but each plot continued to receive annual applications of phosphoric acid and Nitrogen. Where the large applications of potassium salts had been made previously, it was found that timothy and clover were much better able to persist than elsewhere. The influence of the previous applications of potassium salts still continued in a most striking manner even the third year, in all cases where large amounts were used at that time as was fully demonstrated by the much greater yields of hay.

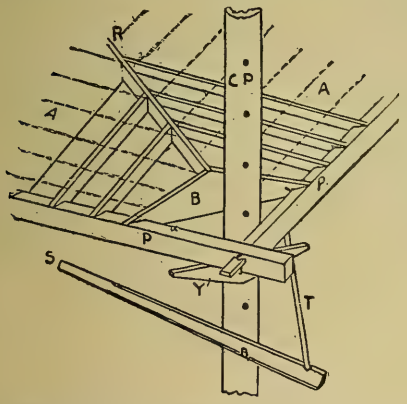
Considerable evidence was afforded that the earlier applications of sodium salts were now helpful by way of increasing the crops of hay *in those cases where the previous applications of potassium salts had been large.* It seems possible that this may have been due, in part at least, to the retention in the soil of a part of the previous applications of potassium salts, by virtue of extra soda having been taken up by the preceding crops in the place of superfluous potash, whereby the potash supply in the soil was really conserved.

Owing to the marked peculiarities of different varieties of plants, it was not expected that direct manurial benefit to the grass would necessarily result from the use of the sodium salts, even if such a direct effect might possibly occur in the growth of radishes, beets, turnips, and certain other plants.

Stack Cover or Barrack.

Extract from *The Ohio Farmer* (Dec., 1905).

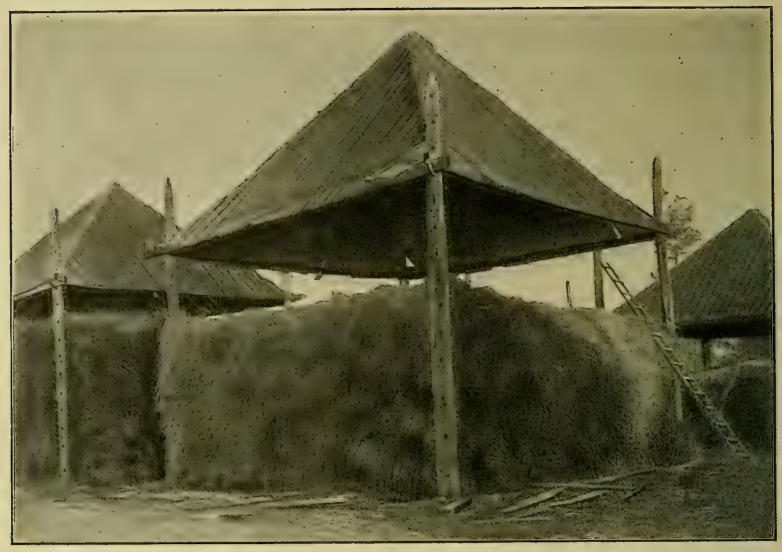
J. E., Avery, O., requests that we publish a portable roof for stacks, one that can be raised and lowered. We present a brief description and picture that first appeared in The Ohio Farmer of February 20, 1904.



BARRACK FRAME—CP, corner post; R, rafter; B, brace; P, plate; Y, yoke; T, temple; S, sweep; AA, roof boards.

The diagram, herewith, shows the true way to frame around the corner post and the manner of arranging the sweep for raising and lowering. Four straight chestnut poles 22 feet long are selected from the woods and bored with holes one foot apart to receive the bolts which support the roof. They are set four feet in the ground and 18 feet apart, as that is a convenient size to make a barrack. The plates are four by six inches, made of white pine or some other light wood, as is all the material of the roof. Lightness is important and the roof boards are made of one-half inch material. The brace across the corner is made of 2-inch plank spiked strongly to the

plates. It is of such a height that the rafter which rests on it if projected through the corner post, would meet the frame at intersection of the plates. The roof boards are cut around the corners, leaving a hole a few inches larger than the corner posts. A little rain that gets in at the corners or through the roof does practically no harm as the open



Stack Cover or Barrack for Hay. In use in New Jersey.

condition of the barrack favors quick drying. Barracks are much to be preferred to stacking; are convenient and cheaply built.—G. Davis.

General Directions for Staple Crops.

The use of Nitrate of Soda alone is never recommended, except at the rate of not more than one hundred pounds to the acre. It may be thus safely and profitably used without other fertilizers. It may be applied at this rate as a top-dressing in the Spring of the year, as soon as vegetation begins to turn green; or, in other words, as soon as the crops begin new growth. At this rate very satisfactory results are usually obtained without the use of any other fertilizer, and the Soda residual, after the Nitrogenous ammoniate food of this chemical is used up by the plant, has a perceptible effect in sweetening sour land.

When it is desired to use a larger amount than one hundred pounds per acre of Nitrate of Soda as a top-dressing, or in any other way, there must be present some form of phosphatic and potassic fertilizer, and we recommend not less than two hundred and fifty pounds of either acid phosphate; or fine ground raw rock; or Peruvian guano; and two hundred and fifty pounds of some high-grade potash salt, preferably the sulphate. A much larger amount than one hundred pounds of Nitrate per acre, when used alone on staple crops, is generally sure to give an unprofitable and unbalanced food ration to the plant. For

Hay Press in Operation.

market gardening crops, however, somewhat more may be used alone. When the above amounts of phosphatic and potassic fertilizers are used, as much as three hundred pounds of Nitrate of Soda may be applied with profit. In applying Nitrate in any ration it is desirable to mix it with an equal quantity of land plaster or fine, dry loam or sand.

Generally on the Pacific Coast Nitrate may be applied as a Top-Dressing after the heavy Spring rains are over, but before crops attain much of a start.

Table Showing Prices of Nitrate of Soda on the Ammoniate Basis.

Figured on Basis of 380 Pounds Ammonia in One Ton of Nitrate of Soda.

Price per Cwt. of Nitrate.	Price per Ton of Nitrate.	Price Ammonia per lb. as Nitrate.	Equivalent Price Ammonia per Ton unit.	Equivalent Cost of Nitrogen per lb.
$1.85	$37.00	$0.097	$1.95	$0.118
1.90	38.00	0.100	2.00	0.122
1.95	39.00	0.103	2.05	0.125
2.00	40.00	0.105	2.10	0.128
2.05	41.00	0.108	2.16	0.131
2.10	42.00	0.111	2.21	0.134
2.15	43.00	0.113	2.26	0.137
2.20	44.00	0.116	2.31	0.140
2.25	45.00	0.118	2.37	0.144
2.30	46.00	0.121	2.42	0.147
2.35	47.00	0.124	2.47	0.150
2.40	48.00	0.126	2.53	0.153
2.45	49.00	0.129	2.58	0.156
2.50	50.00	0.132	2.63	0.159
2.55	51.00	0.134	2.68	0.162
2.60	52.00	0.137	2.73	0.165
2.65	53.00	0.140	2.78	0.168
2.70	54.00	0.143	2.83	0.173

This table enables one to compare commercial quotations on ammoniates with accuracy. The figures themselves are not quotations in any sense of the word, and all the figures of the table refer only to one grade of Nitrate of Soda, namely: that containing 15.65 per cent. of Nitrogen, equivalent to 19.00 per cent. of ammonia. It is prepared merely in order that purchasers may compare the price of Nitrate of Soda which is always quoted by the hundred pounds, with the other ammoniates, which are quoted by the ton unit. In the first column, therefore, are given the prices per hundred weight of Nitrate of Soda; in the second

column, the corresponding prices per ton; in the third column, the cost of the contained ammonia per pound, a figure which is always discussed, but almost never explained in Station Bulletins; in the fourth column, the equivalent price of the ammonia per ton unit, and in the fifth column are given the corresponding prices of the cost of the Nitrogen per pound, a figure also much discussed, but not explained

Hay Press in Operation— Another View.

in Bulletins. The important figures to remember are the price per hundred weight, the price per ton and the equivalent price of the ammonia in the Nitrate per *ton unit*. *The table is prepared to cover fluctuations in price running from one dollar and eighty cents* per hundred, to *two dollars and seventy cents* per hundred; or from *thirty-six dollars*, to *fifty-four dollars* per ton.

Increased Yield per Acre of Crops receiving Nitrate of Soda over those receiving none.

Wheat, . . 19 bushels	Sweet Potatoes, 87 bushels	Onions, . 5,400 pounds
Oats, . . . 28 bushels	Hay, ... 4,880 pounds	Turnips, . . 37 per cent
Corn, . . . 24 bushels	Cotton, . . . 700 pounds	Strawberries, 816 quarts
Barley, . . 20 bushels	Sugar Beets, 14,150 pounds	Asparagus, 280 bunches
Potatoes, 76¾ bushels	Cabbages, . 23,200 pounds	Celery, ... $276.55
	Carrots, . . . 546 bushels	Tomatoes, 218 baskets

Index.

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The Harder Manufacturing Company,

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This machine is recommended for Pressing Hay, and has been found to do excellent work in practical trials.

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